



# Taking the hot air out of drying

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# The clothes dryer



66  
TWh<sub>e</sub>/yr

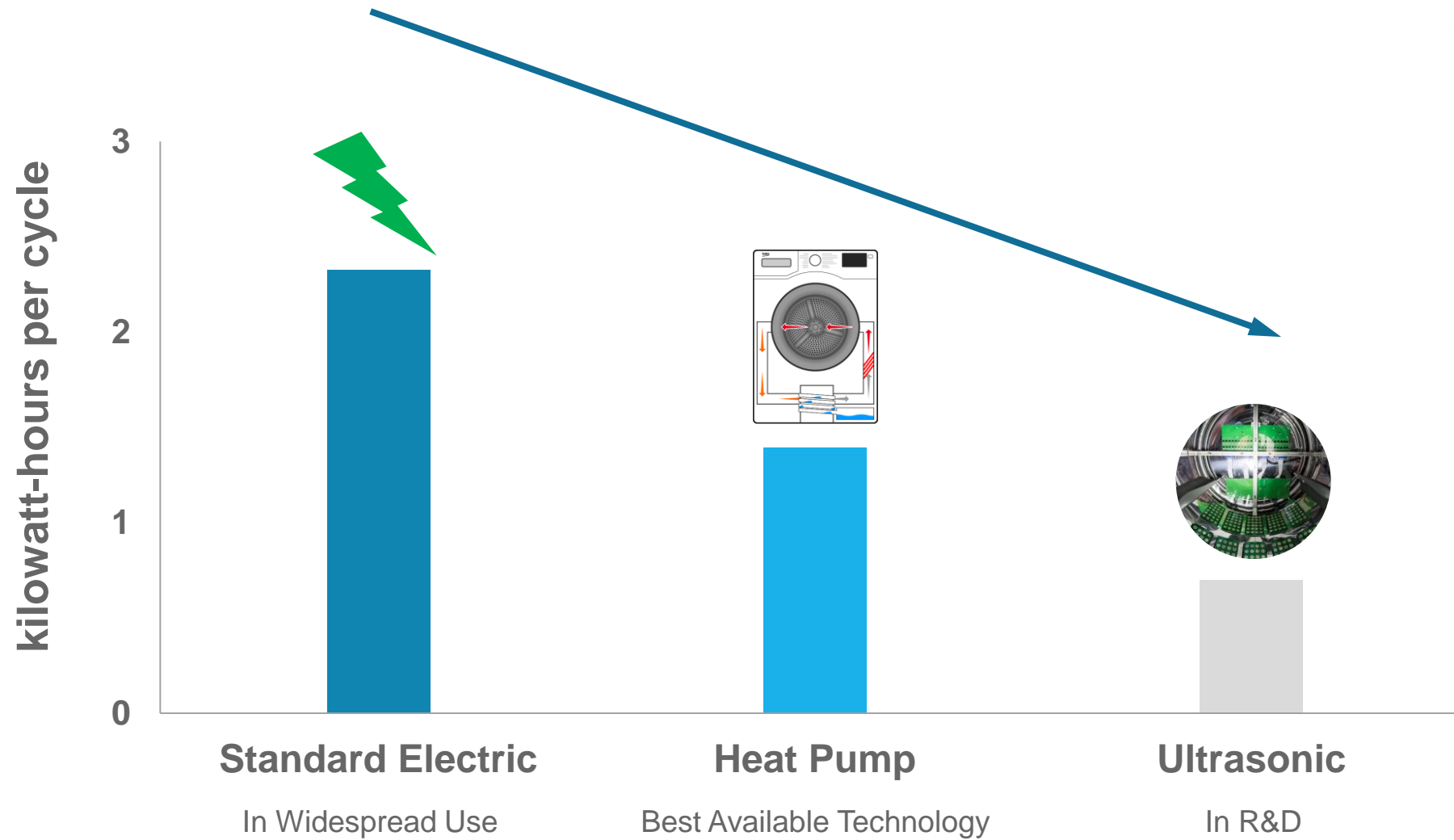
CO<sub>2</sub>

30  
Mt CO<sub>2</sub>/yr



5-10%  
avg. house  
elec. bill

# But we've made some progress



# So how low can we go?





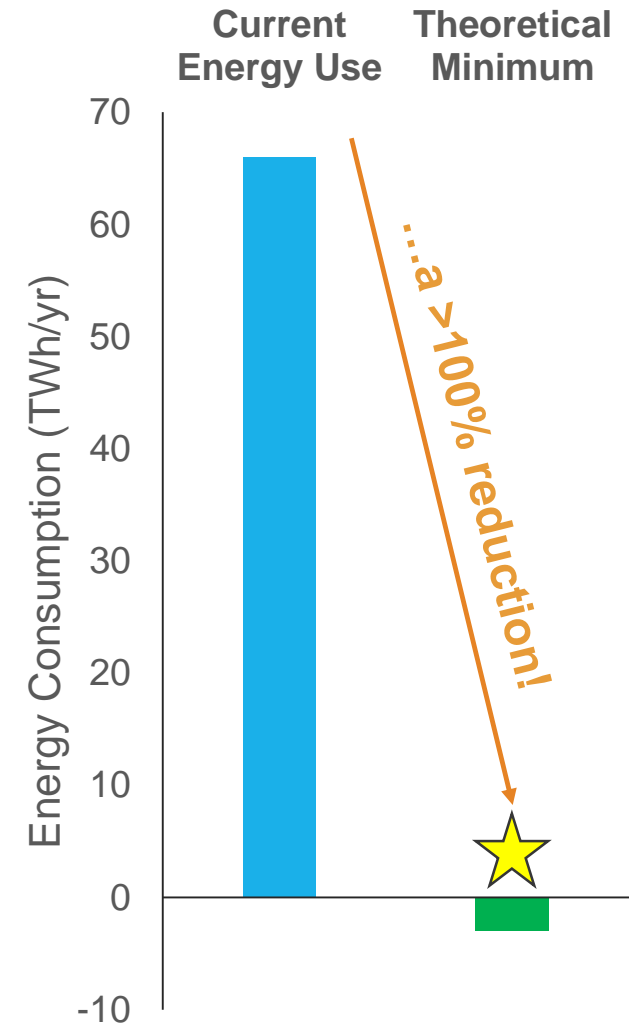
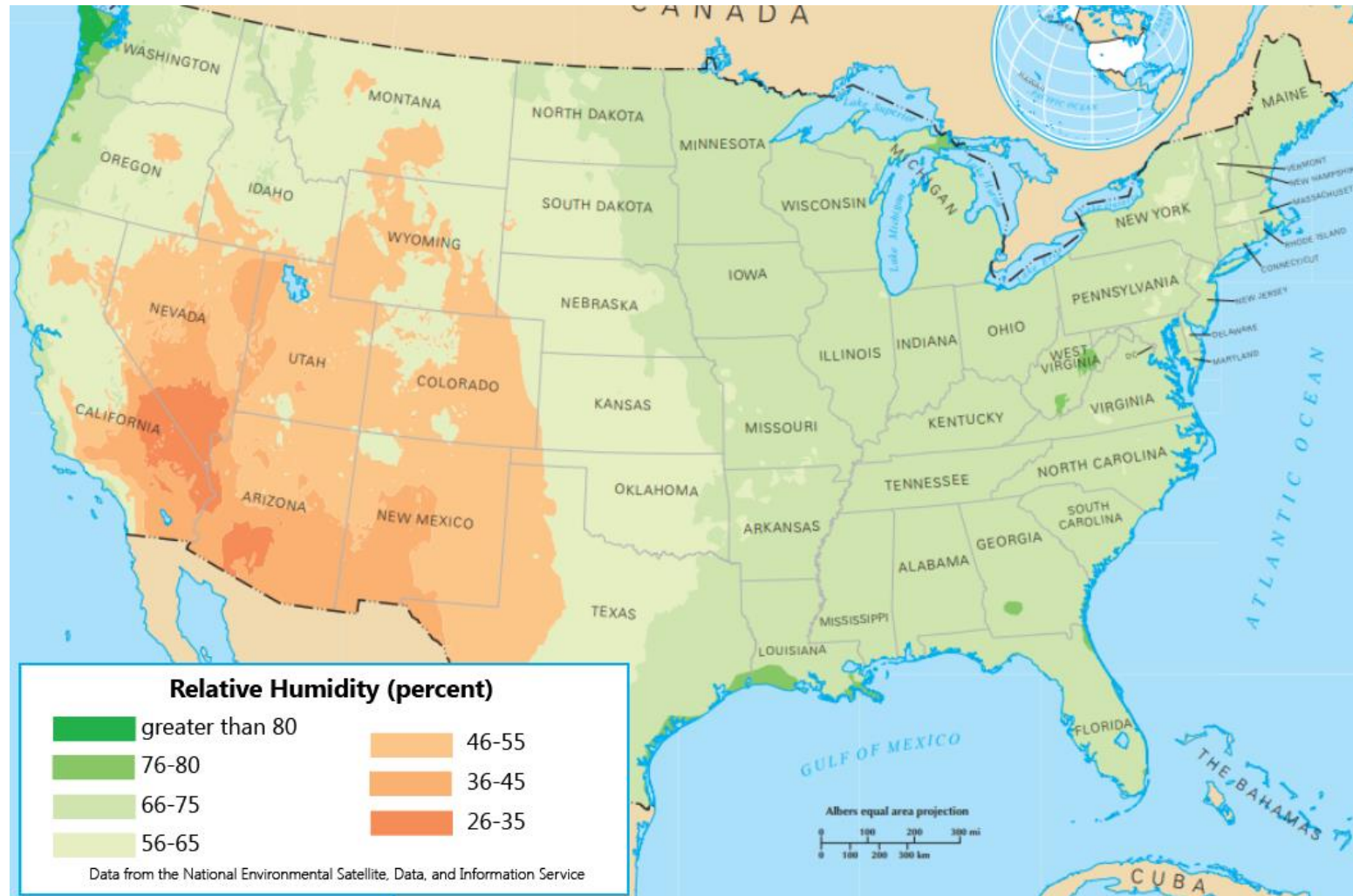
$$\eta = \frac{\text{Minimum Energy Required}}{\text{Actual Energy Consumed}}$$






$$RH = \frac{\text{Vapor Pressure of Water in Air}}{\text{Saturation Vapor Pressure of Water in Air}} \leq 100\%$$

# Drying clothes is thermodynamically free







**On the industrial  
scale, the opportunity  
for savings is even  
bigger.**

removal of water and  
organic compounds

**1.2**  
quads/yr

# Here, too, we've seen progress



INDUSTRY

Ford to Expand Use of 3-Wet Paint Technology; 2-Wet Process to Debut on CVs

Powder & Solids

## Drying Research Heats Up

Efforts promise to improve the efficiency of industrial operations

By Seán Ottewell, editor at large  
Sep 12, 2018

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Non-thermal hybrid drying of fruits and vegetables: A review of current technologies

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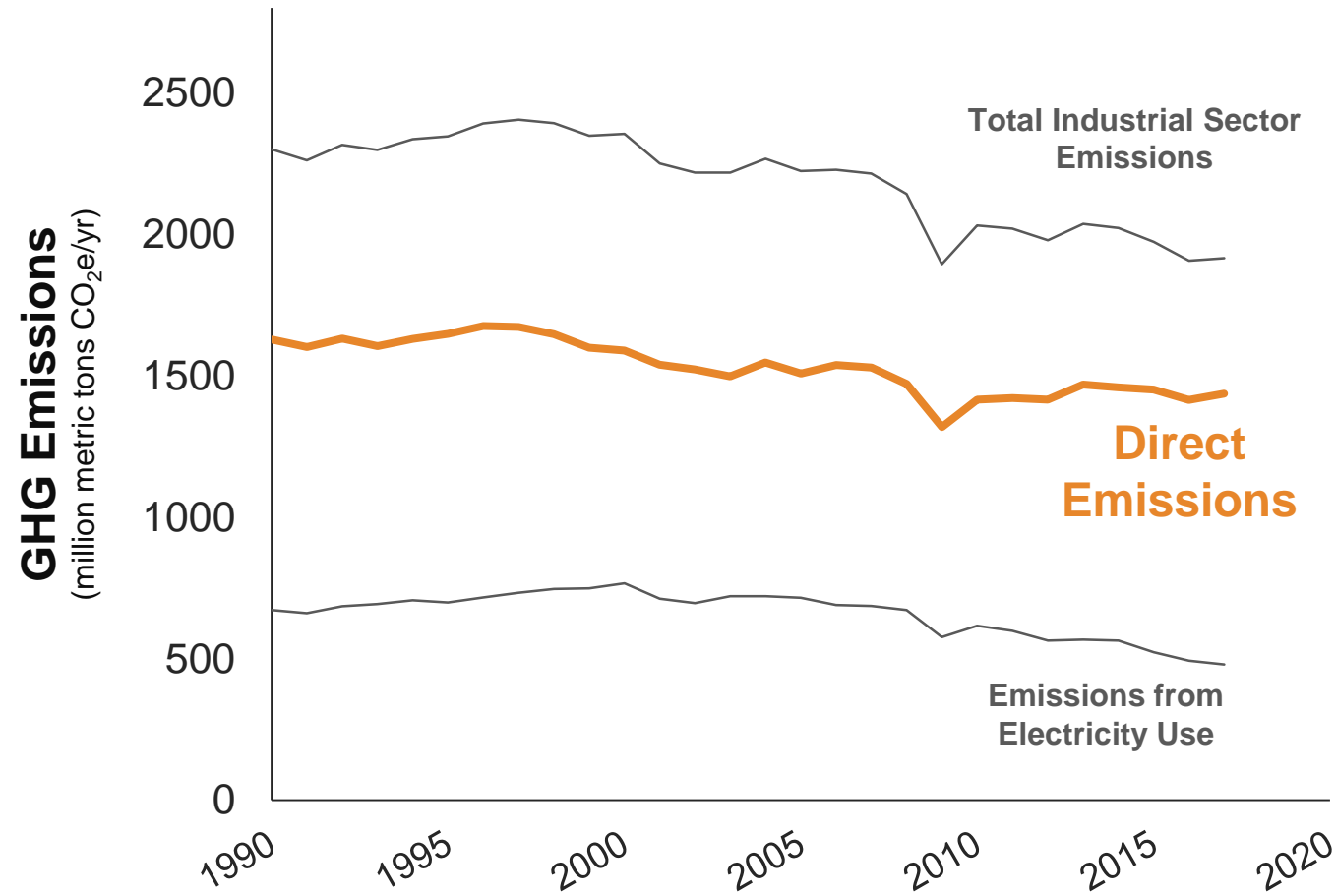
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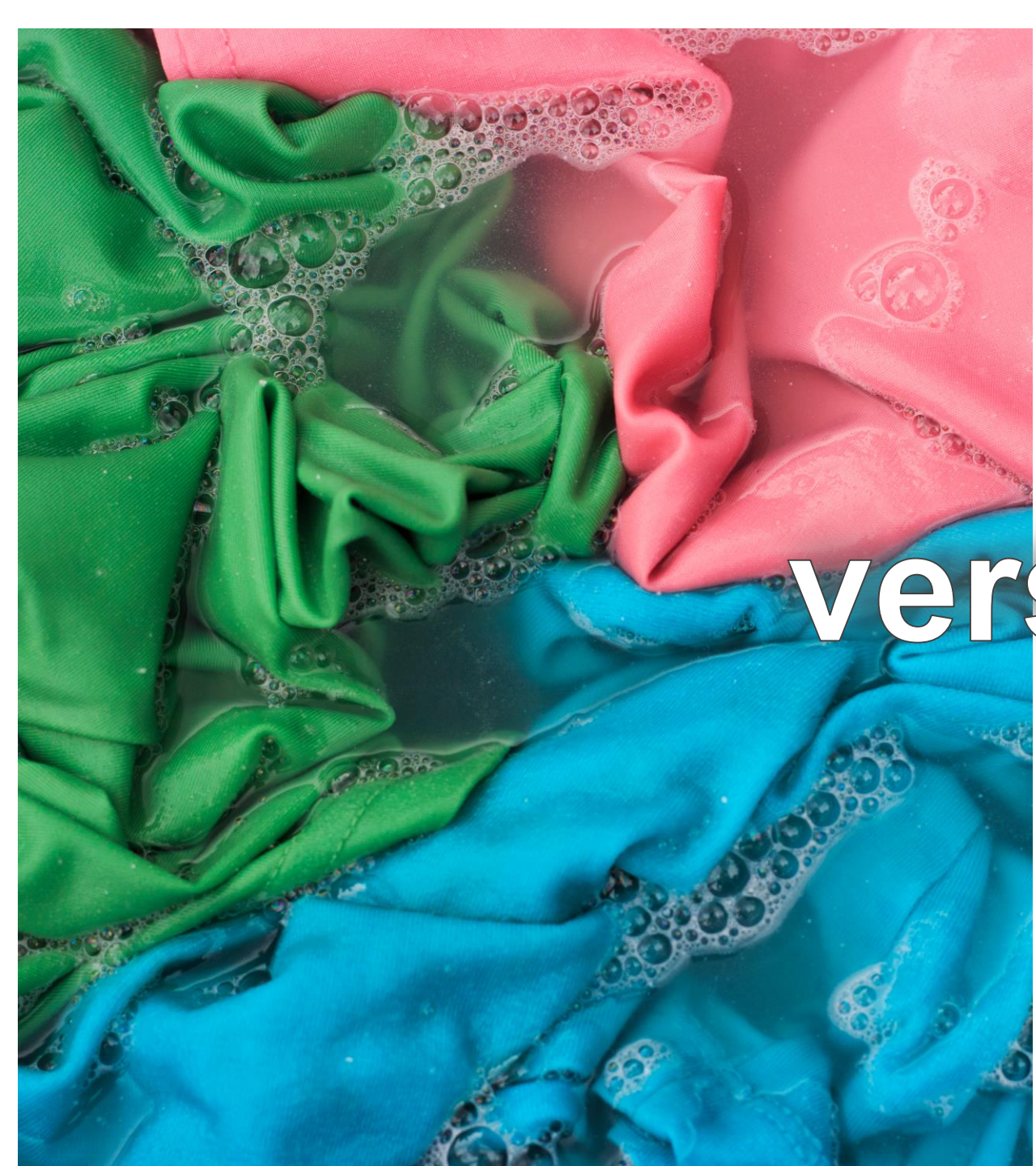
- Process changes
- Low- or zero-carbon energy
- Enhanced heating technologies
- Ultrasonics
- Electrically-driven methods

# ... but it's **not enough**



Data source: EPA Inventory of Greenhouse Gas Sources and Sinks, 1990-2017





versus





# Build out the non-evaporative drying portfolio

vaporization is **one** tool in a toolbox for drying by moving water



- Process changes
- Low- or zero-carbon energy
- Enhanced heating technologies
- Ultrasonics
- ... ?

# My ask

- ▶ If you're interested in...
  - Saving our homes and industries money
  - Advancing our drying technology toolbox
  - Making dryers low energy and low carbon
  - Rethinking thermal energy use in our industries

Please send me your thoughts, ideas, and white papers:

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